



**Ministry of Health and Long-Term Care  
Research Projects  
Final Report Form**



**PDA EVALUATION, PHASE 2  
The Emerging Role of PDAs in Evidence Based Practice:  
An Evaluation Among Frontline Nurses**

Final Report to the Nursing Secretariat  
Ontario Ministry of Health and Long-Term Care

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## Executive Summary

This study evaluated the PDA Initiative of the Nursing Secretariat, Ministry of Health and Long-Term Care (MOHLTC). In response to a call for proposals, the Nursing Secretariat of the Ministry of Health funded 24 health care organizations in Ontario to purchase mobile Personal Digital Assistants (PDAs) or Tablet PCs for nurses as a vehicle to access evidence-based resources at the point of care. Funding was awarded to hospitals, long-term care facilities, and community-based organizations which included both public health units and home care nursing providers. The team led by Dr. Doran at the University of Toronto was funded to conduct an evaluation of the MOHLTC 'PDA initiative'. The evaluation provides an in-depth examination of the organizational context factors and individual variables that influence nurses' use of PDAs or Tablet PCs to access information resources to support clinical decision making and patient care, and assesses its impact on nurses' information needs, job satisfaction, and quality of care.

Three core electronic resources were made available to nurses via their PDAs or Tablet PCs: medical reference and drug handbook (either PEPID or Lexi, as chosen by each site), Best Practice Guidelines from the Registered Nurses' Association of Ontario which were formatted for PDAs or Tablets, and also access to Nursing+, a service that provides e-mail alerts to registered users on personally-selected topics and a searchable database of journal articles that have been rated for their clinical relevance and newsworthiness. Most organizations chose to add additional links or applications to their devices.

A mixed methods research design was used to answer the following research questions:

1. What are the frequencies of use of the three electronic resources; namely, RAO Best Practice Guidelines (BPGs), Nursing+, and Lexi/PEPID?
2. How does organizational context, specifically, presence of electronic documentation, leadership, culture, opportunity for evaluation feedback, information sharing interaction, information sharing activities, structural and electronic resources, and organizational slack, predict the frequency with which nurses use PDAs (or Tablet PCs) to access information resources?
3. How do nurse characteristics, specifically experience in the current unit, education, practice role, attitude towards research, belief, problem solving style, and burnout predict the frequency with which nurses use PDAs (or Tablet PCs) to access information resources?
4. How satisfied are nurses with the different types of information resources?
5. Does the provision of PDA (Tablet)-supported evidence-based practice resources result in: i) improvement in nurses' perceived information needs; ii) improvement in nurses' job satisfaction; and iii) improvement in nurses' perceptions of the quality of care?

In order to answer these questions, data were collected through questionnaires at baseline and approximately six months later, interviews with nurses, interviews with project managers and Information Technology representatives from sites, and reflective journals. Nursing+ provided

de-identified data about usage frequencies for the nursing+ resource and these data complemented the self-report data from questionnaires.

The setting included 24 organizations representing three sectors: hospitals, long-term care facilities, and community organizations (home care and public health). The total sample consisted of 728 participants (response rate 58%) at Time 1 and 504 participants at Time 2 follow-up (response rate 67%). The 'average' participant was a 45 year-old female with 19.2 years of experience in nursing, 8.5 years on current unit and 12.7 years in current organization. The majority of nurses worked full-time, an average of 37.7 hours each week. The majority of participants (60.0%) had received a diploma as their highest level of nursing education. The participants had worked in their current role for an average of 11.9 years. Participants were mostly working in staff level positions (73.3%), while 22.4% were in roles such as clinical support, team leader, coordinator or supervisor. Managers/directors represented 3.8% of study participants.

### **Key Findings**

- Almost 53% of the nurses used a PDA or Tablet at least once very few days or more often, with nurses in Community (64.8%) and Hospital (54.5%) using the devices more frequently than nurses in LTC (36%).
- The majority of nurses reported that having access to the information resources via PDAs or Tablet PCs supported their learning needs.
- Nurses with PDAs used the devices more often than nurses with Tablets.
- Hospital and community nurses used the PDA/handheld devices more frequently than LTC, while the Tablets were used more frequently in long term care. In addition, a small sample of 39 nurses used both devices during the study period.
- Older nurses used mobile devices more often than the younger study participants.
- RN(EC) nurses used mobile devices less frequently than RPNs.
- Nurses who worked in clinical support roles, educator, team leader, coordinator or supervisors used mobile devices more often than staff nurses.
- Nurses who used a mobile device every few days or more often reported a more positive attitude towards research, than nurses who never or almost never used a mobile device.
- When looking for information, nurses accessed Google most frequently, followed closely by medical and drug reference information (i.e. PEPID or Lexi).
- When using Nursing+ and accessing online journal articles, 73% of respondents found something that they didn't know or had forgotten; 65% found something useful for clinical practice; 12% found something that changed their clinical practice.
- Community nurses had fewer logins to Nursing+ through e-mail alerts than those working in hospitals.
- Baccalaureate prepared nurses had more logins to Nursing + through e-mail alerts than diploma/certificate nurses, and conducted more searches for journal articles.
- Older nurses had fewer logins to Nursing+ through e-mail alerts than younger nurses.

- Users whose devices provided access to more resources and functions, such as accessing medical records, e-mail, telephone, used the devices more often than nurses whose devices included core resources only.
- Staff nurses used RNAO Best Practice Guidelines less frequently than managers and nurses whose roles included clinical support, educator, team leader, coordinator or supervisor.
- Nurses who had access to more structural and electronic resources were more frequent users of RNAO BPGs.
- Nurses who scored higher in problem-solving and information sharing activities conducted more database searches for journal articles
- Job satisfaction and quality of care at follow-up were significantly associated with job satisfaction and quality of care at baseline.
- Nurses who scored higher in emotional exhaustion reported lower perceptions of quality of care than less-emotionally exhausted nurses.
- RNs rated quality of care lower than RPNs.

In conclusion, use of PDAs and tablet computers for accessing information resources supported nurses learning needs. Nurses who used PDAs for multiple functions, such as accessing reference information, medical records, e-mail, and telephone, used their device more frequently than nurses who used Tablets and/or had access to limited functions on their device. Nurses who worked in clinical support roles and had higher education were more frequent users. Nurses were most satisfied with the RNAO-best practice guidelines, however all information resources were evaluated favourably. There was a significant improvement in nurses' job satisfaction over time, which was not specifically related to the type of device nurses used.

## Main Messages

- Almost 53% of the nurses used a PDA or Tablet at least once very few days or more often, with nurses in Community (64.8%) and Hospital (54.5%) using the devices more frequently than nurses in LTC (36%).
- The majority of nurses reported that having access to the information resources via PDAs or Tablet PCs supported their learning needs.
- Nurses with PDAs used the devices more often than nurses with Tablets.
- Hospital and community nurses used the mobile devices more frequently than LTC while the Tablets were used more frequently in long term care. In addition, a small sample of 39 nurses used both devices during the study period.
- Older nurses used mobile devices more often than the younger study participants.
- RN(EC) nurses used mobile devices less frequently than RPNs.
- Nurses who worked in clinical support roles, educator, team leader, coordinator or supervisors used mobile devices more often than staff nurses.
- Nurses who used a mobile device every few days or more often reported a more positive attitude towards research, than nurses who never or almost never used a mobile device.
- When looking for information, nurses accessed Google most frequently, followed closely by medical and drug reference information (i.e. PEPID or Lexi).
- When using Nursing+ and accessing online journal articles, 73% of respondents found something that they didn't know or had forgotten; 65% found something useful for clinical practice; 12% found something that changed their clinical practice.
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- Users whose devices provided access to more resources and functions, such as accessing medical records, e-mail, telephone, used the devices more often than nurses whose devices included core resources only.
- Staff nurses used RNAO BPGs less frequently than managers and nurses whose roles included clinical support, educator, team leader, coordinator or supervisor.
- Nurses who had access to more structural and electronic resources were more frequent users of RNAO BPGs.
- Nurses who scored higher in problem-solving and information sharing activities conducted more database searches for journal articles
- Job satisfaction and quality of care at follow-up were significantly associated with job satisfaction and quality of care at baseline.
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## Chapter 1: Study Overview

### Introduction

This study is an evaluation of the PDA Initiative of the Nursing Secretariat, Ministry of Health and Long-Term Care (MOHLTC). The Nursing Secretariat funded 24 health care organizations in Ontario to purchase mobile Personal Digital Assistants (PDAs) or Tablet PCs for nurses to use to access evidence-based resources at the point of care. Funding was awarded to hospitals, long term care facilities, and community-based organizations that included both home care organizations and public health units.

### Background and Purpose

One of the challenges facing health care professionals today is to be able to effectively and efficiently manage an ever-increasing amount of clinical-related health information. A crucial dimension of that challenge is to make the information accessible at times of decision making. Mobile information terminals, such as personal digital assistants (PDAs), have the potential to address that challenge by bringing the most relevant information directly to the point of care. For nurses, providing information through convenient electronic sources may address some of the barriers that inhibit their access to and clinical use of new and pertinent research.

Nurses, like all health professionals, must make informed decisions about appropriate interventions for their patient or patient population drawing upon different sources of evidence. However, regularly accessing information that is current and reliable continues to be a challenge for front-line staff nurses. For example being task driven and coping with heavy workloads limits their attention to and recognition of potential information needs and knowledge gaps [1]. McKnight observed critical care nurses' information seeking was limited to obtaining patient-specific information from people (the patient and families), the chart, and other existing clinical information systems [2]. Designing appropriate systems to facilitate timely access to information could be important to increase evidence-based practice in such demanding work environments. For instance, Estabrooks and colleagues suggest that Internet use by nurses could be increased if the information available on the Internet was more dynamic and more contextually relevant, and if computer access was more conveniently available to them [3]. Recognizing this need, the Ministry of Health and Long-Term Care (MOHLTC), Nursing Secretariat PDA initiative was developed to provide nurses with Personal Digital Assistants (PDAs) and mobile Tablet Personal Computers (PCs) in order to facilitate their access to current and pertinent information at the point of care. The MOHLTC PDA initiative enabled access to three core electronic resources for the mobile devices: drug and medical reference materials, best practice guidelines from the Registered Nurses' Association of Ontario (RNAO), and Nursing+. The Registered Nurses' Association of Ontario (RNAO) provided training workshops and follow-up support to assist organizations participating in the initiative to teach nurses how to use the mobile devices and to access the information resources. Each participating organization chose which units or teams received the PDAs or Tablet PCs and arranged to help

their staff learn how to use the devices and how to access the various electronic resources. The research study is an evaluation of the MOHLTC 'PDA initiative'.

Our previous research indicated significant variation in nurses' utilization of PDAs/Tablet PCs for information access[4]. Some of this variation was explained by differences among nurses (e.g., "I am computer shy"); however, much of the variation was explained by differences across organizations. The organizational factors that contribute to such variation in electronically-mediated information use are not well understood. This gap in knowledge provided the impetus for the current study.

The **purpose** of this evaluation was to investigate the role of organizational context and nurse characteristics in explaining variation in the use of PDAs and mobile Tablet PCs for accessing evidence based information at the point of care. The goal was to identify critical success factors that supported diffusion of technology, evidence based practice, and workplace learning through e-resources.

### Objectives

This study provided an in-depth examination of the individual and organizational context variables that influence nurses' utilization of PDAs/mobile Tablet PCs to access e-resources and support evidence based practice. More specifically, it answers the following research questions:

1. What are the frequencies of use of the three nursing electronic resources; namely, RNAO BPGs, Nursing+, and Lexi/PEPID resources?
2. How does organizational context, specifically, presence of electronic documentation, leadership, culture, opportunity for evaluation feedback, information sharing interaction, information sharing activities, structural and electronic resources, and organizational slack, predict the frequency with which nurses use PDAs (or Tablet PCs) to access information resources?
3. How do nurse characteristics, specifically experience in the current unit, education, practice role, attitude towards research, belief, problem solving style, and burnout predict the frequency with which nurses' use PDAs (or Tablet PCs) to access information resources?
4. How satisfied are nurses with the different types of information resources?
5. Does the provision of PDA (Tablet PC)-supported evidence-based practice resources result in: i) improvement in nurses' information needs, ii) improvement in job satisfaction, and iii) improvement in nurses' perceptions of the quality of care?

The study was guided by 4 objectives:

1. Describe the pattern of use of PDAs/Tablet PCs for accessing information resources.
2. Describe the individual factors that influence variation in PDA/Tablet-PC use.
3. Describe the organizational context factors that influence variation in PDA/Tablet-PC use.
4. Describe nurses' satisfaction with the information resources, their met information needs, and their job satisfaction.

### **Theoretical Perspective**

Two theoretical perspectives provided a framework for studying the impact of providing nurses with PDA-supported evidence based practice resources, and for studying the organizational, technological and human resource variables that impact end user adoption. The first was Diffusion of Innovation theory[5], which suggests that technology adoption is influenced by the following factors: relative advantage (over other ideas), compatibility (e.g., with existing values), complexity (ease of use), trialability, and observability. This study focused on the type of technology (PDA or Tablet PC; type of information resource), compatibility with personal preferences, and perceived complexity. The second theoretical perspective was the Promoting Action on Research Implementation in Health Services (PARIHS) model [6, 7], which suggests that successful implementation of evidence into practice is a function of the relationship between a) the nature of the evidence, b) the context in which practice change will occur (prevailing culture, the leadership roles assigned, and measurement and feedback), and c) the mechanisms by which the change is facilitated [6, 7].

## Chapter 2: Study Design

### Study Design

A mixed methods research design, involving baseline (T1) and follow up (T2) questionnaires, reflective journal, staff nurse Interview, and joint interviews with nursing leadership/ Information Technology representative, was used to answer the research questions. An additional component included monitoring the frequency of use of one of the electronic resources, Nursing+.

### Setting and Sample

The setting included 24 organizations representing three sectors: hospitals, long-term care facilities, and community organizations (home care and public health). The total sample consisted of 728 participants (response rate 58%) at Time 1 and 504 participants at Time 2 follow-up (response rate 67%). All but 3 participants were nurses. The 3 non-nurses were professionals who work closely with nurses at their organization. Each organization determined independently which nurses would be provided with access to the mobile devices. All of the nurses who were using PDAs or Tablet PCs as part of the MOHLTC Initiative were eligible to participate in the study.

### Time Line

From June 2009 to March 2010.

### Implementation

Organizations participating in the Nursing Secretariat's PDA Initiative provided their nurses with a personal PDA or a shared Tablet computer and access to electronic information resources. Each organization was responsible for configuring the PDAs/Tablet PCs to enable access to the various resources either using the health care organization's local area network or through a mobile network. Some but not all organizations provided nurses with corporate e-mail accounts, a new service for many nurses, and a pre-requisite for using all of the features of Nursing+, which sends e-mail alerts to registered users with links to journal abstracts on topics selected by the user. The Nursing Secretariat made arrangements with the Registered Nurses' Association of Ontario (RNAO) to provide education and support sessions to sites, including a train-the-trainer model for nurse education. Each site then developed a strategy for teaching and supporting its nurses. At least one site chose to conduct its own education sessions instead of using the RNAO program.

### Recruitment Process

Each participating organization provided a list of the nurses who were expected to participate in the PDA Initiative. An information package prepared by the research team was distributed to eligible nurses by the site liaisons. The package included a Baseline Questionnaire and two copies of the information letter/consent. It also included two self-addressed stamped

envelopes, one to return the questionnaire and a second to return the consent form. Sites had the option of completing the questionnaire online. For the online sites, the information package included the consent form and details about how to access the online questionnaire.

Approximately 3 weeks after the packages were distributed, a Thank You/Reminder was distributed, and duplicate packages were sent to non-respondents approximately three weeks later. When nurses indicated on the consent form that they were interested in learning more about the optional study components (telephone interview or simulation exercise), their names were added to a list for subsequent random sampling and follow-up. One organization did not release the names of eligible nurses to the research team, and so consent forms were distributed by the Site Liaison and then questionnaires were sent out after a consent form was received by the research team. As part of its contract with the MOHLTC, each organization agreed that nurses would be able to participate in the evaluation activities of the PDA Initiative during regular working hours.

### Data Collection Tools

Data were collected through questionnaires, interviews, and reflective journals. Data from the T1 questionnaire were linked with the T2 data for each participant.

**Organizational Context:** In order to investigate the influence of Rogers' Diffusion of Innovation variables and PARIHS model variables, data were collected on the following variables at the time of the baseline assessment (T1): *leadership* (Cronbach alpha 0.91), *culture* (0.79), *evaluation* (0.92), *information sharing interactions* (0.80), *information sharing activities* (0.66), *information sharing social processes* (0.80), *structural and electronic resources* (0.78), and *organizational slack* (0.88) using the Alberta Context Tool (ACT)[8]. Data were also collected on *knowledge translation*[9] (one item), *organizational support* [10] (one item), *attitude towards research* [10] (Cronbach alpha 0.81), *belief, willingness to use research* (Cronbach alpha 0.80), and *belief, implementation of research* (Cronbach alpha 0.87) [10], and *problem solving*[11] (Cronbach alpha 0.72).

**Burnout:** The Maslach Burnout Inventory – General Survey (MBI-GS)[12, 13] was used to measure burnout. The MBI-GS is a 16-item self-report questionnaire that measures three aspects of burnout: emotional exhaustion (9-items), depersonalization (5-items), and decreased personal accomplishments (8-items). A condensed 9-item version of the questionnaire was used in this study. Using a 7-point Likert scale (never to every day) respondents were asked to indicate “how often” they experienced the content of the items. A higher score indicates a high level of burnout. Psychometric properties of the MBI-GS are well established. Reported Cronbach's alpha reliabilities for the three subscales range from 0.71 to 0.91 and test-retest reliabilities range from 0.60 to 0.82[12]. In several studies, factor analyses have confirmed the 16-item, 3 factor structure in a variety of samples from different countries [12]. The Cronbach alpha in this study was 0.75 for cynicism, 0.75 for professional efficacy, and 0.86 for emotional exhaustion.

**Job satisfaction:** A 4-item global measure of job satisfaction was used. Using a 4-point Likert scale (very dissatisfied to very satisfied), respondents were asked to rate their overall level of

satisfaction with 1) their present job and 2) being a nurse (independent of current job). A higher score indicates a high level of job satisfaction[14]. A confirmatory factor analysis revealed a good fit of the hypothesized factor with standardized factor loadings of 0.68 to 0.81[15]. The modified scale has been used in several nursing populations and has been found to have good internal consistency with Cronbach alpha's ranging from 0.82 to 0.84 [14-16]. Job satisfaction was measured on both the baseline and the follow-up questionnaires to enable analysis using paired t-tests. Cronbach alpha was 0.81 and 0.87 at T1 and T2 respectively.

***Frequency of use of information resources:*** Nurses were asked to respond to a series of questions on the T2 questionnaire to assess the frequency with which they used the information resources, ranging from “never”, “almost never”, “every few days”, “daily” and “more than once a day”. They were asked to rate their satisfaction looking for information using the PDA (Tablet PC), satisfaction with the electronic resources, perceived impact on evidence based practice, perceived impact on information needs, and perceived impact on patient care.

***Semi-Structured Interviews:*** Semi-structured telephone interviews were conducted with a randomly selected stratified sub-sample of 14 nurses over a three month period (8 hospital, 1 LTC, 5 Community). The aim was to sample nurses at different stages of implementation, commencing at least 4 weeks after their initial use of the technologies. Each nurse was interviewed once. The interviews explored nurses’ perceptions about the value of the e-Health tools for facilitating evidence-based practice, barriers to use, success factors, and opportunities for improvement. Towards the end of data collection (months 4-5), the project’s senior nurse leader (or delegate) and the project’s IT representative were invited to participate in a joint telephone interview to describe their organizations’ experience with the PDA initiative, success factors, perceived costs, and impact on organizational outcomes, including patient/client care. Representatives from seventeen organizations were interviewed, including 12 hospitals, 3 LTC organizations and 2 community organizations. Each interview lasted approximately 20 minutes and was audio-taped with the consent of the participants. Interviews were transcribed. The transcripts were then compared with the audio-recording to confirm accuracy. The interviewer also documented the participants’ comments on an interview template during each interview. A thematic analysis of the transcripts was conducted.

***Reflective Journal:*** A randomly selected stratified sample of nurses was invited to participate in reflective journaling. Stratification was based on health care sector. In order to reduce respondent burden, nurses were invited to participate in either the interviews or the journal activity but not both. Reflective journals were utilized to address questions related to nurses’ experience using PDAs/Tablet-PCs to access information resources. Nurses were asked to describe the care-giving activity in which they were engaged and the issue that prompted their search, the device they used, their experience searching for information/evidence, the situational factors that affected their use of the device, the resources they sought, and the impact of their search on clinical decision making/ clinical care. Fifteen nurses participated in the reflective journals: 12 (80%) from hospitals, 2 (13%) from LTC and 1 (7%) from community.

**Nursing+:** Nurses' use pattern and information search preferences were collected electronically through the Nursing+ system[17] and presented in de-identified summary reports. Data were also collected through self-report on the follow-up questionnaire. For nurses who consented to participate in this component of the evaluation, research staff at McMaster University (led by Dr. Brian Haynes, one of the Co-Investigators) tabulated aggregate data from 324 participants (range from 0 to 52 per site). Data includes how often the Best Evidence for Nursing + database was used to search for journal abstracts, how often abstracts that had been sent to users were actually looked at, and also user feedback about the usefulness of the "search" and the "e-mail alerts" in the opinion of the users. Users' choice to use a PDA or a personal computer when logging into the Nursing+ resource was also tracked.

**Registered Nurses' Association of Ontario (RNAO) Best Practice Guidelines (BPGs) and PEPID/Lexi resources:** Nurses' use pattern, preferences for best practice guideline information, and perceived clinical utility were collected through self-report on the follow-up questionnaire at T2.

## Chapter 3: Study Results

Chapter 3 provides a description of the participants and the findings related to each research question. Throughout this document, the term Personal Digital Device, or PDA, refers to all handheld devices, including PDAs, smart phones, BlackBerries, etc. The term “Tablet” or “Tablet PC” includes tablets, netbooks, laptops and other mobile devices that are too large to be held in one hand.

### Nurse Participants

The number of nurses who participated in the study is summarized in Table 1.

*Table 1: Number of Nurse Participants by Sector*

Sector	# Participants	# RNs (%)	#RPNs (%)	#RN (EC) (%)
<b>BASELINE</b>				
Hospital	468 (64.3%)	360 (77.9)	83 (18.0)	19 (4.1)
Community	123 (16.9%)	104 (85.3)	18 (14.8)	0 (0)
Long Term Care	137 (18.8%)	66 (48.9)	68 (50.4)	1 (0.7)
TOTAL	728 (100%)	530 (73.7)	169 (23.5)	20 (2.8)
<b>FOLLOWUP</b>				
Hospital	314 (62.3%)	223 (78.1)	48 (16.8)	15 (5.2)
Community	89 (17.7%)	80 (90.9)	8 (9.1)	0
Long Term Care	101 (20.0%)	49 (53.3)	43 (46.7)	0
TOTAL	504 (100%)	352 (75.5)	99 (21.2)	15 (3.2)

The remainder of this report includes data provided by the nurses who participated at both Baseline and Follow-up, unless otherwise stated. The demographic profile of participants is summarized in Table 2. The ‘average’ participant was a 45 year-old female with 19.2 years of experience in nursing, 8.5 years on current unit and 12.7 years in current organization. The majority of nurses worked full-time, an average of 37.7 hours each week. The majority of participants (60.0%) had received a diploma as their highest level of nursing education.

*Table 2: Demographic Profile of Nurse Participants*

Characteristics	Mean (min max)	SD
Age (n=426)	44.7 (21-68))	10.1
Number of hours worked in typical week (n=456)	37.7 (8-78)	9.6
Experience in nursing (yrs) (n=457)	19.2 (0.8-46)	11.4
Experience in current organization (yrs) (n=461)	12.7 (0.8-40)	10.2
Experience on current unit (yrs) (n=455)	8.5 (0.8-40)	7.9

Gender (N=464)		n	%
	Female	445	95.9
	Male	19	4.1
Employment Status (N=464)			
	Full-time	353	76.1
	Part-time	105	22.6
	Casual	6	1.3
Highest Education (n=716)			
	Diploma/Certificate	278	60.4
	Bachelor's Degree	140	30.2
	Master's or Doctorate	45	9.7

### Role of Study Participants

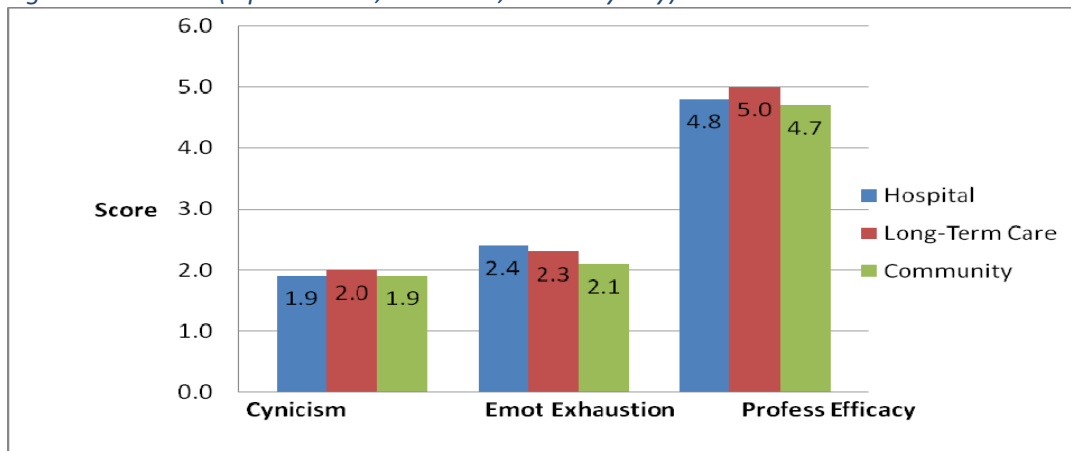
Role	# Participants (%), Baseline n=714	# Participants (%), Final n=479
Staff	523 (73.3%)	321 (67.0%)
Clinical support, team leader, coordinator, supervisor	160 (22.4%)	132 (27.6%)
Manager, director	27 (3.8%)	23 (4.8%)
Other	4 (0.6%)	3 (0.6%)

The participants had worked in their current role for an average of 11.9 years (range 0.8 – 38.0, sd 10.5).

### Burnout

Figure 1 presents data from 471 participants' self-appraised burnout, based on the Maslach Burnout Inventory, GS. High scores represent higher levels of cynicism, emotional exhaustion, and professional efficacy.

Figure 1: Burnout (7 point scale; 0 = never, 6 = every day)



## Problem Solving

Participants' scores on the Problem Solving Inventory[11] are reported in Table 3. The differences among sectors are not statistically significant.

*Table 3: Problem Solving, range 1 to 5; self-appraisal, high score reflects more effective problem-solver*

Sector	n	Mean (sd)
Hospital	288	3.9 (0.39)
Long-term care	93	3.8 (0.36)
Community	89	3.9 (0.37)

## Devices Used

Handheld devices (PDA, Smartphone, BlackBerry etc.) were used by 163 participants who completed the follow-up questionnaire and indicated that they were using a mobile device. Tablets (including Netbooks and laptops) were used by 173 participants. A small group of 39 participants used both a PDA and a Tablet device as part of the PDA initiative. Handheld PDAs were more frequently used in hospitals, and laptops more common in LTC and community settings.

## Results: Research Questions

**Research Question 1.** The first research question asked, "What are the frequencies of use of the three nursing electronic resources; namely, RNAO BPGs, Nursing+, and Lexi/PEPID resources? The frequency with which a PDA or Tablet PC was used in this initiative is shown in Figure 2 and Table 4. Almost 53% of the nurses used a PDA or Tablet at least once very few days or more often, with nurses in Community (64.8%) and Hospital (54.5%) using the devices most frequently than nurses in LTC (36%). Tablet and other lap-sized devices were used more frequently than the handheld devices, however this varied by sector. Hospital and community nurses used the PDA/handheld devices more frequently while the Tablets were used more frequently in long term care. In addition, a small sample of 39 nurses used both devices during the study period. A combination of local wireless networks, local fixed networks and mobile networks from a variety of service providers were represented in the study.

Figure 2: Self-Reported Frequency of Device Use

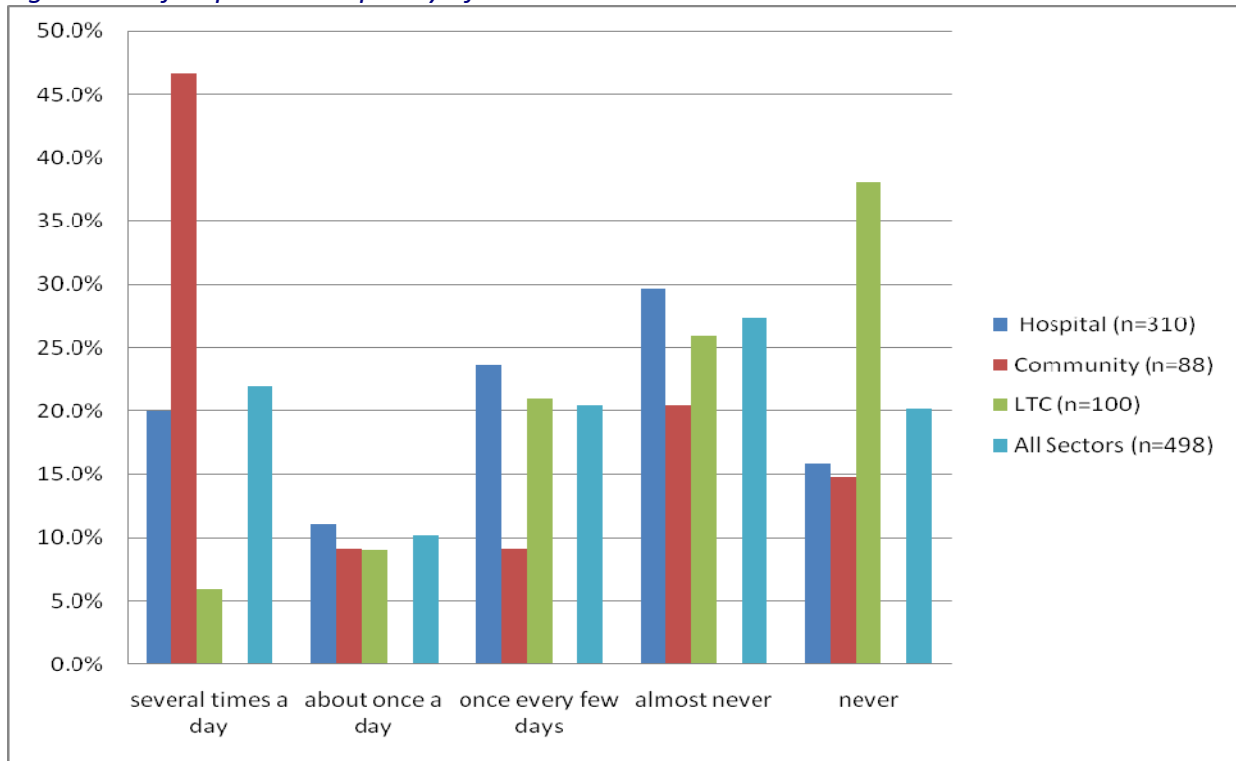


Table 4: Use of PDA/Tablet Devices During Study

	Overall		Hospital		Community		LTC	
	n	%	n	%	n	%	n	%
<i>Used a Mobile Device</i>								
Several times a day	109	21.9	62	20	41	46.6	6	6
About once a day	51	10.2	34	11.0	8	9.1	9	9
Once every few days	102	20.5	73	23.6	8	9.1	21	21
Almost never	136	27.3	92	29.7	18	20.5	26	26
Never	100	20.1	49	15.8	13	14.8	38	38
Total number of responses	498		310		88		100	
<i>As part of initiative</i>								
Used PDA	163	43.5	131	52.6	20	48.2	12	21.8
Used Tablet	173	46.1	99	39.8	44	62	30	54.6
Used both PDA & Tablet	39	10.4	19	7.6	7	9.9	13	23.6

### Reasons for Not Using Mobile Devices

Eighty-nine nurses reported reasons why they “never” used a PDA or Tablet during the study, offering 96 responses as explanation. Table 5 provides a summary of the reasons identified by nurses from each sector.

*Table 5: Reasons for not using mobile devices*

Hospitals	Long-Term Care Facilities	Community Settings
Equipment not working (15)	Not available (10)	Not available (9)
Takes too much time (14)	Takes too much time (5)	Lack of training (2)
User-Friendliness (8)	Equipment not working (5)	User-Friendliness (3)
Difficult to access (4)	User-Friendliness (5)	No Need for work purposes (2)
Lack of training (2)	Lack of Training (4)	
No need for PDA on unit (3)		
Not available (2)		
Not offered the opportunity (3)		

\*Reasons listed in order of those named most frequently to those reported less frequently

### Information Resources

Nurses were provided with 3 core information resources: a drug handbook (PEPID or Lexi), RNAO Best Practice Guidelines, and Nursing +. Most organizations chose to add additional resources such as corporate policies, clinical documentation, and other in-house resources. Nurses were asked to record how often they used their PDA/Tablet PC to access each resource during a typical week. Table 6 shows the percentage of nurses who accessed each resource at least once every few days or more often. This table shows that nurses accessed Google most frequently, followed closely by medical and drug reference information.

*Table 6: Frequency of Resource Use*

Resource	% of Nurses who Used Resource at least every few days
Google	42.1
Medical reference information	41.4
Drug dictionary	39.4
In-house resources	32.3
Nursing + e-mail alerts	31.5
RNAO BPGs	31.4
Laboratory Values	29.1
Calculator	23.2
Search Nursing+ database	22.2
IV compatibility guidelines	15.6

Nurses were asked to indicate the location where they typically accessed the information resources. The majority accessed the resources away from the point-of-care (see Table 7).

*Table 7: Location where participants accessed electronic resources*

Resource (n)	Point-of-Care only		Away from point-of-care		Both at and away from point-of-care	
	n	%	n	%	N	%
Drug Handbook (329)	48	14.6	163	49.5	118	35.9
BPGs (308)	43	14.0	193	62.7	72	23.4
BEN+ (293)	36	12.3	196	66.9	61	20.8

Differences in the frequency with which nurses reported using the information resources were examined. When the results were examined by device used, the results showed that nurses who used a Tablet PC accessed Google and in-house resources significantly more often than nurses who used a PDA (Fisher's exact test  $p < .05$ ). In contrast, nurses who used a PDA accessed PEPID or Lexi (drug dictionary, medical reference) and the calculator, significantly more often than nurses who used a Tablet PC ( $p < .05$  and  $p < 0.01$  respectively).

### **Nursing +, Best Evidence for Nursing**

A total of 551 people registered with the Nursing+ resource, indicating that they were participating in the PDA project. The following data refers to the 324 participants who consented to monitoring of their use pattern. Of the 324 users, 297 signed on to Nursing+ at least once. Four (1.2%) used a PDA only, 242 (81.5%) used a Tablet or Desktop PC, and 51 (17.2%) used both a PDA and a Tablet/Desktop; of the latter group, the Tablet/Desktop usage was 75.3%. The cumulative number of logins is presented in Table 8.

*Table 8: From June 01, 2009 to January 31, 2010 there were 1937 logins to nursing+ (83 with a PDA and 1854 with a Tablet PC or Desktop PC)*

Login Summary	Accessed with both methods		Accessed with a PDA		Accessed with a Tablet PC or Desktop PC	
	Accesses (n=1937)	% of Total	Accesses (n=83)	% of Total	Accesses (n=1854)	% of Total
Login via an e-mail alert	1514	78.15%	25	30.12%	1489	80.31%
Login via nursing+ web page	423	21.84%	58	69.88%	365	19.69%

E-mail alerts are sent to participants, matched to their personal nursing disciplines, patient population(s), and practice setting(s), that provide citation information for new critically appraised, nursing rated research and review articles, their ratings and links to their full-text (if available). The frequency of e-mail alerts and topics for alerts are customizable.

Table 9: From June 01, 2009 to January 31, 2010 there were 584 searches within nursing+ (28 with a PDA and 556 with a Tablet PC or Desktop PC) \*

Search Type	Accessed with both methods		Accessed with a PDA		Accessed with a Tablet PC or Desktop PC	
	Searches (n=584)	% of Total	Clicks (n=28)	% of Total	Clicks (n=556)	% of Total
Advanced Search	34	5.82%	2	7.14%	32	5.76%
Quick Search	550	94.18%	26	92.86%	524	94.24%

\* A user may perform several searches during one visit to the search page and this is reported as several searches.

Table 10: From June 01, 2009 to January 31, 2010 there were 2122 article records accessed within nursing+ (102 with a PDA and 2020 with a Tablet PC or Desktop PC)

Article Records Accessed From	Accessed with both methods		Accessed with a PDA		Accessed with a Tablet PC or Desktop PC	
	Accesses (n=2174)	% of Total	Clicks (n=102)	% of Total	Clicks (n=2072)	% of Total
Advanced Search	4	0.19%	0	0.00%	4	0.20%
Featured Article	40	1.89%	0	0.00%	40	1.98%
Hit Parade (all disciplines)	25	1.18%	0	0.00%	25	1.24%
Hit Parade (user's disciplines)	441	20.78%	42	41.18%	399	19.75%
New Articles	1295	61.03%	37	36.27%	1258	63.28%
Quick Search	308	14.51%	22	21.57%	286	14.16%
Saved Articles	9	0.42%	1	0.98%	8	0.40%

### User feedback to online alert questionnaire popup

The questions in Table 11 were presented 1295 times when participants clicked on an article record in their New Articles list. The questions were presented using the following algorithm: not on the 1st visit, then after clicking on an article record in their New Articles list, then repeating after the earlier of 10 visits or 30 days after the previous questionnaire was answered. 113 responses were received (8.73% response rate).

*Table 11: User feedback after clicking on an article in the New Articles list*

Question	Yes	No	Not sure	No answer
1. Did you find something interesting that you didn't know (or had forgotten)?	82 (73%)	17	14	0
2. Did you find something that could be useful in your clinical practice?	74 (65%)	18	21	0
3. Did you find something that changed your clinical practice?	14 (12%)	57	42	0

**Research Question 2.** The second research question asked, “How does organizational context, specifically, presence of electronic documentation, leadership, culture, opportunity for evaluation feedback, information sharing interaction, information sharing activities, structural and electronic resources, and organizational slack, predict the frequency with which nurses use PDAs (or Tablet PCs) to access information resources? Table 12 provides the T test values for differences between mean scores for nurses who used the PDA/Tablet PC every few days or more often and those who almost never or never used the device. Nurses who used the PDA/Tablet PC more often reported positive attitudes towards research utilization, more time to provide care, more willingness to put aside past beliefs to adopt new ideas based on research, and more deliberative problem-solving style. They also worked in organizational settings where the culture supported research utilization, where there were opportunities for informal interactions, information sharing social processes, where there were formal information sharing activities such as team meetings, and where there were structural and electronic resources to support research utilization.

*Table 12: Alberta Context Tool scores, based on frequency of use of PDA or Tablet*

	Used mobile device never or almost never		Used mobile device every few days or more often		t	p
	n	Mean (sd)	n	Mean (sd)		
Attitude toward research **	214	3.9 (0.5)	252	4.1 (0.5)	-3.7	0.0003
Time**	213	2.9 (0.7)	250	3.2 (0.7)	-3.5	0.0005
Culture**	213	3.9 (0.6)	251	4.0 (0.6)	-3.2	0.0014
Social capital**	212	4.0 (0.5)	252	4.1 (0.5)	-2.6	0.0087
Problem Solving**	214	3.8 (0.4)	251	3.9 (0.4)	-2.6	0.0093
Informal Interactions *	223	2.4 (1.6)	258	2.8 (1.7)	-2.6	0.0111
Structural & Electronic	223	1.1 (1.1)	258	1.3 (1.1)	-2.3	0.0245

Resources*						
Evaluation*	211	3.1 (0.9)	250	3.3 (0.8)	-2.2	0.0254
Formal interactions*	223	1.7 (1.2)	258	1.9 (1.3)	-2.2	0.0304
Belief Suspension: implement research*	202	3.2 (1.9)	241	3.5 (0.9)	-2.3	0.0198

\*Statistically significant,  $p < 0.05$  \*\*  $p < 0.01$

Leadership, space, staff, quality of care, burnout: not statistically significant

Table 13 provides the T test values for differences between mean scores for nurses who used the RNAO Best Practice guidelines (BPGs) every few days or more often and those who almost never or never used the RNAO BPGs. Nurses who used the RNAO BPGs more often reported positive attitudes towards research utilization, more time to provide care, more willingness to put aside past beliefs to adopt new ideas based on research, and more deliberative problem-solving style. They also worked in organizational settings where the culture supported research utilization, where there were opportunities for informal interactions, information sharing social processes, where there were formal information sharing activities such as team meetings, and where there were structural and electronic resources to support research utilization.

*Table 13: Alberta Context Tool scores and Burnout, based on frequency of use of RNAO BPG Use*

	Used RNAO BPG never or almost never		Used RNAO BPG every few days or more often		t	p
	n	Mean (sd)	n	Mean (sd)		
Attitude toward research **	257	3.9 (0.5)	114	4.2 (0.5)	-3.0	0.004
Time**	256	3.0 (0.7)	114	3.2 (0.6)	-2.9	0.004
Culture**	256	4.0 (0.6)	113	4.1 (0.5)	-3.1	0.002
Social capital**	256	4.0 (0.5)	113	4.2 (0.5)	-2.4	0.02
Problem Solving**	256	3.8 (0.4)	114	3.9 (0.4)	-2.2	0.032
Informal Interactions *	223	2.4 (1.6)	258	2.8 (1.7)	-2.6	0.0111
Structural & Electronic Resources*	263	1.2 (1.0)	117	1.6 (1.1)	-3.7	0.0000
Formal interactions*	223	1.7 (1.2)	258	1.9 (1.3)	-2.2	0.0304
Belief Suspension: implement research*	252	3.9 (0.6)	112	4.1 (0.6)	-3.0	0.003
MBI Emotional Exhaustion	255	2.4 (1.5)	113	2.07 (1.4)	1.98	0.05
MBI Professional Efficacy	254	4.7 (1.2)	114	5.0 (0.99)	-2.2	0.03

\*Statistically significant,  $p < 0.05$  \*\*  $p < 0.01$

Leadership, evaluation, space, staff, organizational support: not statistically significant

Table 14 provides the T test values for differences between mean scores for nurses who searched the Ben+ database every few days or more often and those who almost never or never searched the BEN+ database. Nurses who searched BEN+ database more often reported

positive attitudes towards research utilization, more time to provide care, more willingness to put aside past beliefs to adopt new ideas based on research, and more deliberative problem-solving style. They also worked in organizational settings where the culture supported research utilization, where leadership was positive, where there were opportunities for evaluation and feedback, where there were opportunities for informal interactions, information sharing social processes, where there were formal information sharing activities such as team meetings, and where there were structural and electronic resources to support research utilization.

*Table 14: Alberta Context Tool scores and Burnout, based on frequency of searching BEN+ Database*

	Used RNAO BPG never or almost never		Used RNAO BPG every few days or more often		t	p
	n	Mean (sd)	n	Mean (sd)		
Attitude toward research**	285	4.0 (0.5)	86	4.2 (0.5)	-4.0	0.000
Time*	284	3.1 (0.7)	86	3.2 (0.6)	-2.3	0.02
Leadership*	282	3.7 (0.8)	86	3.9 (0.8)	-2.0	0.05
Culture**	283	4.0 (0.6)	86	4.2 (0.5)	-3.5	0.001
Social capital*	284	4.0 (0.5)	85	4.2 (0.6)	-2.5	0.02
Evaluation**	281	3.2 (0.4)	85	3.5 (0.9)	-3.1	0.003
Problem Solving*	284	3.9 (0.4)	86	4.0 (0.4)	-2.4	0.02
Informal Interactions**	293	2.6 (1.6)	87	3.3 (1.7)	-3.1	0.003
Structural & Electronic** Resources	293	1.2 (1.0)	87	1.6 (1.1)	-2.9	0.005
Formal interactions*	293	1.9 (1.2)	87	2.2 (1.3)	-2.1	0.04
Belief Suspension: implement research**	280	3.9 (0.6)	84	4.2 (0.6)	-4.0	0.003

\*Statistically significant,  $p < 0.05$  \*\*  $p < 0.01$

Table 15 provides the T test values for differences between mean scores for nurses who responded to Ben+ email alerts every few days or more often and those who almost never or never responded to BEN+ email alerts. Nurses who searched BEN+ database more often reported positive attitudes towards research utilization, more time to provide care, more willingness to put aside past beliefs to adopt new ideas based on research, and more deliberative problem-solving style. They also worked in organizational settings where the culture supported research utilization, where leadership was positive, where there were opportunities for evaluation and feedback, where there were opportunities for informal interactions, information sharing social processes, where there were formal information sharing activities such as team meetings, and where there were structural and electronic resources to support research utilization.

Table 15: Alberta Context Tool scores and Burnout, based on frequency of responding to BEN+ email alerts

	Used RNAO BPG never or almost never		Used RNAO BPG every few days or more often		t	p
	n	Mean (sd)	n	Mean (sd)		
Attitude toward research**	247	4.0 (0.5)	122	4.2 (0.5)	-4.0	0.000
Time**	246	3.0 (0.7)	122	3.3 (0.6)	-3.2	0.002
Leadership*	245	3.7 (0.8)	121	3.9 (0.8)	-2.2	0.03
Culture**	245	3.9 (0.6)	122	4.2 (0.5)	-4.0	0.000
Social capital*	246	4.0 (0.5)	121	4.2 (0.5)	-2.4	0.02
Evaluation*	243	3.2 (0.9)	121	3.4 (0.9)	-2.1	0.04
Problem Solving**	246	3.8 (0.4)	122	4.0 (0.4)	-2.0	0.003
Informal Interactions*	255	2.6 (1.7)	123	3.1 (1.7)	-2.3	0.02
Structural & Electronic** Resources	255	1.2 (1.0)	123	1.6 (1.0)	-3.2	0.002
Belief Suspension:** implement research	243	3.9 (0.7)	119	4.1 (0.6)	-2.7	0.007
MBI Cynicism*	244	2.0 (1.5)	121	1.7 (1.4)	2.1	0.04

\*Statistically significant,  $p < 0.05$  \*\*  $p < 0.01$

**Research Question 3.** The third research question asked, “How do nurse characteristics, specifically experience in the current unit, education, practice role, attitude towards research, belief suspension, problem solving style, and burnout predict the frequency with which nurses’ use PDAs (or Tablet PCs) to access information resources?”

Regression analysis was conducted to investigate the extent to which nurse characteristic variables explained variation in PDA/Tablet PC use, RNAO BPG use, and Nursing+ use. The independent variables were the organizational context variables described above (e.g., leadership, culture) and the nurse characteristic variables (e.g., age, role, attitude toward research, etc.). Poisson regression was conducted for the dependent variables that were measured as counts, specifically for Nursing+ e-mail login frequency and Nursing+ searches. Logistic regression was used for the dichotomized frequency of PDA/Tablet use and frequency of RNAO-BPG Use. The results of the regression analysis are summarized in Table 14.

First, with regard to *frequency of PDA/Tablet PC use*, the regression analysis indicated that nurses working in community settings used PDA/Tablet PC more often than nurses working in hospitals. Older nurses used the PDA/Tablet PC more often than younger nurses, whereas RNs(EC)s used the PDA/Tablet less frequently than RPNs. Nurses with PDAs (i.e., hand-held device) were more frequent users than nurses with Tablet PCs. In addition, nurses in clinical support roles, such as educator, team leader, coordinator or supervisor were more frequent

users than staff nurses. A variable was created representing the breadth of activities for which nurses could use the PDA/Tablet PC device, such as accessing patient health records, accessing lab or imaging results, accessing corporate policies, telephone and e-mail communication. This variable was labelled 'technology penetration'. Increased technology penetration was associated with increased PDA/Tablet PC use.

*Frequency of RNAO-BPG Use.* The regression results indicated that staff nurses utilized the RNAO-BPGs less frequently than nurses in support roles such as educator, team leader, etc. In addition, nurses whose work environments had more structural and electronic resources to support research utilization accessed the RNAO BPGs more frequently than those whose work environments did not have strong structural and electronic resources.

*Nursing+ -E-mail Logins.* Nurses working in community settings had lower number of total e-mail logins than nurses working in hospital settings. Nurses with a baccalaureate degree had higher total number of e-mail logins to Nursing+ than nurses with diploma, whereas older nurses had lower total number of e-mail logins than younger nurses.

*Nurse+ Database Searches.* Nurses with a baccalaureate degree had higher total searches in the Nursing+ database than nurses with a diploma. Nurses who scored higher on the problem solving scale and whose work environment had more information sharing activities, such as team meetings, client case review, and informal discussions with colleagues, conducted more searches in Nursing+ than those who scored low on problem-solving and whose work environment had fewer information sharing activities.

Table 14. Regression Analysis for Frequency of PDA/Tablet PC Use, Nursing+, and RNAO Best Practice Guidelines

		nursing+ Total e-mail logins		nursing+ Total Searches		Frequency of PDA/Tablet use		Frequency of RNAO-BPG use	
		Estimate	P	Estimate	P	Estimate	P	Estimate	P
Sector (ref: Hospital)									
	LTC	-0.789	0.42	-1.179	0.54	-0.084	0.85	0.1774	0.68
	Community	-1.198	0.01*	-0.711	0.29	1.121	0.01**	0.6501	0.06
Employment (ref: part-time/Casual)									
	Full time	-0.055	0.89	-0.294	0.65	0.391	0.23	0.1275	0.69
Education (Ref: Diploma/Certificate)									
	Bachelor	1.163	0.00**	1.364	0.04*	0.066	0.86	0.2865	0.39
	Master/PhD	0.881	0.12	-0.837	0.49	0.018	0.97	-0.0861	0.85
Age		-0.05	0.02*	-0.006	0.86	0.036	0.02*	0.0092	0.51
Professional (Ref: RPN)									
	RN	-0.023	0.97	-0.132	0.94	-0.664	0.09	-0.268	0.49
	RN (EC)	-0.763	0.61	-0.242	0.92	-2.043	0.02*	-0.5814	0.49
Device (Ref: Fixed)									
	Both PDA and Tablet	0.469	0.45	0.483	0.63	0.68	0.24	0.1479	0.73
	PDA	0.446	0.19	-0.118	0.83	1.242	0.00**	-0.0621	0.82
Role (Ref: Staff nurse)									
	Clinical support, educator, team leader, coordinator or supervisor	-0.815	0.07	0.193	0.76	0.819	0.03*	0.7383	0.02*
	Manager or Director	-0.819	0.51	0.071	0.96	1.251	0.15	1.2609	0.03*
Problem solving scale				-1.219	0.05*				
ACT information share activities				0.443	0.03*				
Degree of penetration						0.611	0.00**		
ACT Structural and Electronic Resources								0.4602	0.00**
		Pseudo R <sup>2</sup> .24		Pseudo R <sup>2</sup> .31		Pseudo R <sup>2</sup> .23		Pseudo R <sup>2</sup> .10	

\*p<.05 \*\* p <.01

**Research Question 4.** The fourth research question asked, “How satisfied are nurses with the different types of information resources?”

**Satisfaction.** Nurses were asked to rate their satisfaction with each of the resources on a 9-point scale ranging from frustrating to satisfying. Overall, nurses were most satisfied with their experience using the RNAO BPGs. However, when examined by device, nurses who used PDAs were most satisfied with the PEPID or LEXI resource, and the nurses who used Tablet PCs were more satisfied with the RNAO BPG resource and BEN+. There were no statistically significant differences in satisfaction with the information resources by type of device used.

**Ease of Use.** Nurses were asked to rate the ease of using each resource on a 9-point scale ranging from difficult to easy. Overall, nurses rated the RNAO BPG as the easiest to use. Similar to the results for satisfaction levels, nurses who used a PDA found the PEPID or LEXI resource the easiest while nurses who used a Tablet PC found the RNAO BPGs the easiest. There were no statistically significant differences in ease of use by type of device used.

*Table 15: Utility of Resources by Device*

	n	M (sd)
<b>Satisfaction</b> (1=frustrating, 9 = satisfying)		
PEPID or Lexi	269	5.4 (2.5)
Nursing+	266	5.2 (2.4)
RNAO BPGs	273	5.5 (2.4)
<b>Ease of Use</b> (1=difficult, 9=easy)		
PEPID or Lexi	266	5.5 (2.4)
Nursing+	264	5.3 (2.3)
RNAO BPGs	272	5.7 (2.4)

Table 16: User's opinions about usability of devices (9 point scale, range 1-9 for each item.)

Device Characteristics	Overall			PDA			Tablet			t	p
	n	M	SD	n	M	SD	n	M	SD		
Size of Screen	367	5.8	2.5	149	5.5	2.7	161	6.2*	2.3	2.58	.0102
Characters on Screen	367	5.8	2.5	148	5.6	2.6	162	6.1	2.4	1.92	.0555
Amount of Information on Screen	365	6.2	2.2	148	5.8	2.4	160	6.5**	2.0	2.84	.0049
System Speed	361	5.3	2.5	147	5.7**	2.6	159	4.9	2.5	-2.67	.0081
Correcting mistakes	325	5.2	2.6	135	5.6	2.6	141	5.5	2.5	-0.38	.7038
Network Access	352	5.7	2.3	140	5.9	2.4	157	5.5	2.3	-1.13	.2614
Network Stability	346	5.6	2.4	137	5.6	2.6	156	5.6	2.3	-0.1	.9192

\*p<.05    \*\* p<.01

**Device Characteristics.** Nurses were asked to rate seven characteristics of their device on a 9-point scale. Nurses who used a Tablet PC rated the amount of information on the screen, the size of the screen, and the characters on the screen to be significantly more adequate than nurses who used a PDA. In contrast, nurses who used a PDA rated the speed of the PDA significantly faster than nurses who used a Tablet PC. There were no significant differences between other characteristics; however, nurses who used a PDA reported that it was easier to correct mistakes, had better network access and better network stability than laptop users.

**Research Question 5.** The fifth research question asked, “Does the provision of PDA (Tablet PC)-supported evidence-based practice resources result in i) improvement in nurses’ perceived information needs; ii) improvement in nurses’ job satisfaction; and iii) improvement in nurses’ perceptions of the quality of care?”

**Impact of Access to Resources.** Nurses were asked to rate the impact on practice of having access to the various information resources on a scale from 1 (not at all) to 9 (very much so). A score of 5 on the 9-point scale would indicate a neutral opinion, less than 5 would indicate the perception of little impact, and more than 5 would indicate the perception of greater impact. Table 17 reports the results. The majority of nurses reported that having access to these resources had little impact on changing practice but that the resources supported their information or learning needs.

*Table 17: Impact of Access to Information Resources (9 point scale)*

<b>Having access to...</b>	n	mean (SD)
RNAO BPGs changed use of RNAO BPGs	368	3.4 (2.4)
Information resources assisted in clinical practice	379	4.7 (2.7)
Nursing+ assisted in clinical practice	352	3.7 (2.4)
Drug reference information assisted in clinical practice	363	4.5 (2.7)
Resources positively impacted outcomes	369	4.9 (2.9)
Resources support learning needs	375	5.2 (2.8)

### **Job Satisfaction and Quality of Care, Change in Outcomes Over Time**

Paired t-tests were used to evaluate change in the outcomes (i.e. job satisfaction, and quality of care) from baseline to follow-up. The results in Table 18 indicated a significant improvement in job satisfaction over time. However there was a significant reduction in perceived quality of care over time.

*Table 18: Paired t-tests - Changes in Major Study Variables Over Time for Overall Sample*

Variable	n	Time 1 mean (SD)	Time 2 mean (SD)	T value	p
Job Satisfaction	468	3.46 (0.79)	3.57 (0.87)	-3.28	0.001
Quality of Care	465	3.70 (0.70)	3.62 (0.56)	2.73	0.01

Multiple regression analysis was conducted to determine which variables predicted nurses' job satisfaction and perceived quality of care at T2 follow-up. The independent variables were baseline job satisfaction (quality of care) age, sector worked, employment status, education, RN/RPN role, device type, and burnout. The results of the regression analysis are presented below.

*Job Satisfaction.* Only two variables were associated with nurses' job satisfaction. Baseline level of job satisfaction was positively associated with nurses' follow-up job satisfaction scores and emotional exhaustion sub-scale of the Burnout inventory was negatively associated with nurses' job satisfaction.

*Quality of Care.* The perceived quality of care at baseline predicted quality of care at follow-up assessment. In addition, nurses who scored higher on emotional exhaustion rated the quality of care lower, and RNs rated the quality of care lower than RPNs.

Table19: Multiple Regression Analysis for Job Satisfaction and Quality of Care

		Job Satisfaction at Follow up		Quality of Care at Follow up		
		Estimate	P-value	Estimate	P-value	
Sector (Ref: hospital)						
	LTC	0.208	0.12	0.216	0.01	**
	Community	-0.093	0.38	0.088	0.16	
Employment (Ref: part-time/casual)						
	Full time	0.043	0.65	-0.086	0.13	
Education (Ref: Diploma/Certificate)						
	Bachelor	0.141	0.17	0.04	0.51	
	Master/PhD	-0.059	0.69	-0.108	0.22	
Age		0.007	0.11	0.001	0.84	
Professional (Ref: RPN)						
	RN	0.146	0.21	-0.145	0.04	*
	RN (EC)	0.232	0.38	0.233	0.14	
Device (Ref: Tablet)						
	Both Hand-held and Tablet	0.041	0.77	-0.002	0.97	
	Hand-held	-0.001	0.99	0.014	0.79	
Role (Ref: Staff nurse)						
	Clinical support, educator, team leader, coordinator or supervisor	0.053	0.61	0.011	0.86	
	Manager/ Dir	-0.066	0.72	0.108	0.31	
Job Satisfaction, Baseline		0.634	<0.001			**
Quality of Care, Baseline				0.398	0.000	**
MBI Exhaustion				-0.052	0.002	**
MBI Cynicism		-0.063	0.06			
		R <sup>2</sup> =0.41		R <sup>2</sup> =0.39		

\*p<.05 \*\*p<.01

### Telephone Interviews with Nurse Participants

Fourteen nurses participated in a telephone interview. These nurses reported on average they had used their mobile devices for approximately 3.5 months. The interviews were content analyzed and six major themes were identified: device use, barriers, facilitators, outcomes, satisfaction and additional resources. The detailed findings can be obtained from the

corresponding author of the report. The results of the interview data are briefly summarised below.

Nurses reported both barriers and facilitators to using the mobile devices to access information resources. The barriers and facilitators are summarized in Table 20.

*Table 20: Staff Perception of Barriers and Facilitators of Use of PDA/Table PCs*

Barriers	Facilitators
Network issues such as ‘dead spots’	Handheld devices light weight
Some Tablets too big and heavy	Teamwork
Handwriting recognition software problems	Having client information accessible on device
Lack of familiarity with features such as mouse	Device portability
Lack of IT support	User groups for peer support

Nurses identified numerous quality of work life benefits, including:

- Improved work efficiency and effectiveness
- Getting information in a timely manner so that client needs are met
- Enabling more time to complete patient care and other work
- Sense of empowerment and confidence
- Having access to a personal device negated need to compete for access to a desktop computer

Managers and senior IT staff also reported barriers and facilitators, which in some cases, were similar to those identified by nurses and in other cases, were different. These are summarized in Table 21.

*Table 21. Manager and IT Staff Perception of Barriers and Facilitators to PDA/Table PC Use*

Barriers	Facilitators
Battery life of Tablet PCs	IT support
Tablets too heavy and bulky	Dedicated resource nurse
Challenges associated with learning to use peripheral devices such as stylus.	Local website with resources/support
Staff resistance to change	Journal club
Workload	Information resource challenge with prize
Unforeseen costs such as purchase of carrying cases, installation of wall mounts, device maintenance, cost of license renewals	

### **Experiences of Journal Participants**

#### **Nurses’ success in finding answers on the electronic resources**

The Journal participants rated their success in finding answers on the electronic resources. One participant was not at all successful, 6 (40%) were partly successful and 8 (53.3%) were completely successful in finding answers using their mobile electronic resources.

*Table 22: Number of nurses who used electronic resources in journal-based scenario*

	Considered using resource	Looked at resource	Actually used resource	No answer
Medical Reference, includes drug handbook	2	2	9	2
Nursing+, e-mail alerts for journal abstracts	1	2	2	10*
Nursing+ searchable database	1	2	4	8
RNAO Best Practice Guidelines	2	4	3	6
Internet	5**	2	8	0

\*includes one journal participant who was not aware of nursing+

\*\* includes one participant who reported no internet access

Some of the sites used by nurses on the internet included in-house resources, nursing consult, Webmail, Google, CNA NurseONE, McMaster University Library, Institute for Health Information, Wikipedia, World Health Organization, EBSCO support, Joanna Briggs, Google Scholar, RNAO training, Lexi Comp online, College of Nurses, Ryerson library, Up to date and Yahoo.

Feedback from nurses who submitted journals about their experiences using a mobile device, is reported as insights about the devices, learning needs, resources, and networks.

Device:

- needs to be user friendly (large font, large screen; pen/stylus easy to use, need to be able to enter information quickly and accurately, need to correct mistakes quickly and easily without signing out; need fast processor; needs to be reliable)
- needs to interface with other electronic applications and resources
- needs to be easy to carry around without fear of losing it, but not too big or heavy
- nurses still need access to a desktop for improved speed of finding and entering information; still need access to clinical resource colleagues who have the right information at their fingertips.

Learning

- Ongoing support is needed for novice users about how to use device and core resources
- Need time to learn

Resources

- Depth and quality of information was appreciated, but it's not the answer for everyone
- Need to be able to get to the right information quickly, fewest steps possible (e.g. icons for key resources on home page, bookmarks for favourites); spending too much time looking for information takes time away from patient care
- Needs to include PowerPoint for teaching

System, Network

- Need to be able to access a reliable network from all patient/client locations

## Chapter 4: Discussion

### Study Limitations

The study was a natural experiment in which organizations were at liberty to select the device type they would provide their nurses. Therefore it was not possible to balance the number of device types by sector, and as a result, there were some sectors, where a device type was under-represented. This meant it was not possible to fully explore the extent to which the impact of providing nurses with mobile technologies on outcomes was device specific, sector specific, or a combination of the two. Second, as with any natural experiment, it is not possible to control for other extraneous confounding factors that could have influenced the results.

### Discussion

The study explored the potential of mobile information terminals, such as PDAs and Tablet computers, to improve nurses' access to research evidence and other information resources with the overall goal of improving the quality of nurses' worklife and the quality of patient care. The research findings suggest that mobile technologies have the potential to realize these goals.

### Frequency of Use

Prior to the study 73% of the nurses had not used a PDA for personal or work use, 78% had not used a Tablet computer. At the conclusion of the study 53% of the nurse respondents indicated they were using a PDA or Tablet PC once every few days or more often, and 20% indicated that they never used it. Thus the majority of nurses reported a significant increase in use of PDA or Tablet PCs following their participation in the MOHLTC PDA initiative.

### Information Resources

There have been a number of studies that have explored the various resources that nurses utilize and the kinds of knowledge they require in their day-to-day work [18-20]. Royle *et al.* (2000) found that, to access professional information, two thirds of the nurses in their study consulted with colleagues daily, most used reference sources and textbooks weekly, and two thirds of them read journal articles monthly. Thompson *et al.* (2008) found that nurses preferred human sources of information and that colleagues, other members of the primary care team, or senior members of the clinical team were viewed as the most useful and accessible information sources [20]. In another study, observation of nurses information-seeking behaviour through work-sampling methodology confirmed that nurses most often sought information from other colleagues [21]. Nurses expressed stronger preferences for reference information and procedural information than for research information. In that study hospital nurses' top priorities for information resources at the point-of-care were information on intravenous (IV) drug compatibility, a drug dictionary, and IV medication protocols. Access to the types of information identified by these nurses is now readily available on PDAs and other mobile technologies, such as Tablet PCs [22].

Building on that previous research, the Ministry of Health and Long-Term Care PDA initiative provided nurses with access to three information resources via their PDAs/Tablet PCs:

- 1) RNAO Best Practice Guidelines;
- 2) Nursing+ [17], and
- 3) PEPID/Lexi [23, 24].

Nurses also had access at their own discretion to other internet resources and search engines such as Google. The findings from this study indicated that the most frequent resources nurses reported using were Google, drug dictionary and medical reference information, the latter of which were included in the PEPID and Lexi suite. Nurses identified using Nursing+ e-mail alerts more frequently (32%) than searching the Nursing+ database (22%). When asked about the ease of use and satisfaction with the information resources nurses reported the RNAO BPGs were most satisfying and easiest to use.

### **Impact on Learning Needs**

Every care activity involves decision-making. Research indicates that there is significant variation in the decisions that nurses make about appropriate interventions for managing patients' health concerns such as functional impairment, pain, nausea, dyspnea, fatigue, and pressure ulcers [25]. Evidence-based nursing resources could address such variation in nursing practice by providing nurses with reliable information about nursing interventions that have been effective for particular patient concerns. There is evidence to suggest that timely access to research evidence, especially if imbedded into the clinical processes of care, minimizes variation in clinical practice [26]. The results of the current study demonstrate the usefulness of PDAs and tablet computers in delivering this type of decision support to nurses at the point of care. On average, nurses felt that having access to the information resources supported their learning needs, and positively impacted patient outcomes.

### **Organizational Context**

Organizational context has been defined as "...the environment or setting in which people receive healthcare services..." [27](p.229). The organizational context is widely considered to be an important influence on the implementation of research evidence in healthcare settings[28]. Estabrooks et al. developed the Alberta Context Tool to measure eight dimensions of the organizational context: culture, leadership, evaluation, social capital, informal interactions, formal interactions, structural and electronic resources, and organizational slack. The eight dimensions were found to be associated with instrumental research use[28]. In this present study, six of the eight dimensions were associated with increased frequency of PDA/Tablet PC use; specifically, culture, social capital, informal interactions, formal interactions, structural and electronic resources, and evaluation. These features of the organizational context are modifiable and could therefore be the focus of organizational interventions to increase research utilization. Features of the organizational context were also found to influence the frequency of Nurse+ database searches, specifically informal interactions, and the frequency with which nurses accessed RNAO BPGs. With regard to the latter, nurses whose work environment had more structural and electronic resources to support research utilization accessed the RNAO

BPGs more frequently than those whose work environment did not have structural and electronic resources to support evidence based practice.

### **Individual Nurse Determinants of Research Use**

Several individual nurse characteristic variables also predicted PDA/Tablet PC use, as well as use of the information resources. Nurses who scored higher on the problem-solving scale conducted more Nursing+ database searches. Individuals who score high on this scale tend to solve problems by exploring multiple solutions, take time to assess alternatives, and feel confident about their problem-solving ability. Age was found to be positively associated with PDA/Tablet PC use, and this relationship prevailed even after controlling for nursing role within the healthcare organization. Not surprisingly, nurses in support roles such as educator, team leader, and supervisor, used the PDA/Tablet PC more frequently than staff nurses and they also accessed the RNAO BPGs more frequently than staff nurses. This could reflect the fact the advanced practice nurses often assume the role of information resource for other nurses within the organization. Higher education was positively associated with Nursing+ e-mail logins and Nursing+ database searches. This finding is consistent with previous research. In an integrative literature review, Estabrooks et al. concluded that education was the most commonly studied determinant of nurses' research utilization. Findings were about evenly split as either significant and positive or non-significant[9].

### **Breadth and Type of Technology Use**

The breadth of functions for which nurses could use their PDA/Tablet PC device was associated with increased use. More specifically, when nurses were able to use their device to access reference information, medical record information, e-mail, telephone, and text messaging there was greater reported use of the PDA or Tablet PC. This finding is not surprising and it suggests expanding the functionality of technology will increase user adoption.

Nurses who were provided with a PDA tended to use their device more frequently than nurses who were provided with a Tablet computer. This finding is similar to a previous study by Doran et al. (2010), in which it was found that nurses who used PDAs reported significant improvement over time in barriers to research utilization, whereas Table PC users did not demonstrated significant change over time in barriers to research utilization [29]. The qualitative data in this current study suggest that nurses found the PDAs more portable and easier to carry than Tablet PCs, and that in comparison to some Tablet PC models, the PDAs were faster to turn-on and therefore, faster to access the information resources.

### **Impact on Nurses' Job Satisfaction and Quality of Care**

There was a significant improvement in nurses' job satisfaction over time. However in the multiple regression analysis the only predictors of job satisfaction at follow-up were baseline job satisfaction and emotional exhaustion. Therefore it is not possible to confirm that the observed change in job satisfaction was related to nurses' use of the PDA or Tablet PC.

Likewise the only predictors associated with the quality of care at follow-up were baseline quality of care, emotional exhaustion, and nursing role. RNs rated the quality of care lower than RPNs.

A small sub-sample of nurses participated in semi-structured interviews and/or completed a reflective journal documenting their subjective experience using the PDAs/Tablet PCs to access information resources. The qualitative findings underscore some of the perceived benefits to nurses' quality of worklife. Nurses identified positive outcomes such as improved work efficiency and effectiveness, more timely access to information, a sense of empowerment and confidence, and reduced competition for access to desktop computers.

## Conclusion

In conclusion, use of PDAs and Tablet computers for accessing information resources supported nurses' learning needs. Nurses who used PDAs for multiple functions, such as accessing reference information, medical records, e-mail, and telephone, used their device more frequently than nurses who used Tablets and/or had access to limited functions on their device. Nurses who worked in clinical support roles and had higher education were more frequent users relative to staff nurses with a diploma. Nurses were most satisfied with the RNAO-best practice guidelines; however, all information resources were evaluated favourably. There was a significant improvement in nurses' job satisfaction over time; however, this was not related to the type of device nurses used. Several of the organizational context variables explained variation in the frequency of PDA/Tablet PC use and in the frequency with which nurses accessed Nursing+ database and accessed the RNAO BPGs. The organizational context variables, such as leadership, culture, informal and formal interactions, are modifiable and therefore could be the focus of work environment interventions designed to increase nurses' research utilization. Future research involving technology innovation, needs to attend to nurses' work environment in order to create a context that is supportive of change.

## Recommendations

- Technology innovation needs to be 'user friendly', and it needs to interface with other electronic applications, such as access to medical records, e-mail, telephone and organizational resources,
- Handheld portable devices support technology adoption into practice,
- Nurses should be provided with access to electronic resources such as drug and medical reference information, and to best practice information in order to support their learning needs,
- Technology innovation initiatives should adopt change strategies aimed at enhancing organizational culture, leadership, opportunities for formal and informal interactions, and structural and electronic resources to support research utilization .

## Chapter 5: Research Transfer

The research team will prepare a summary report for sharing with the participating sites, and will prepare articles for submission to nursing and health services journals.

### **Presentations:**

Doran, D.M. "Enhancing Evidence Based Practice through Tablet Computers and PDAs: An Evaluation Among Frontline Nurses." Registered Nurses' Association of Ontario Leadership Forum. March 24, 2010.

Doran, Diane M et al "Emerging Role of Information Technology in Evidence-Based Practice: An Evaluation Among Frontline Nurses." American Nursing Informatics Association, April 22-24 2010. Boston MA.

Doran, Diane M. "Does Mobile Technology Support Nurses' Decision Making?" Abstract submitted to Canadian Home Care Association, November 3-5, 2010.

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